

MagnaChip

Analog & Mixed Signal Company

MV MOSFET

Power Marketing

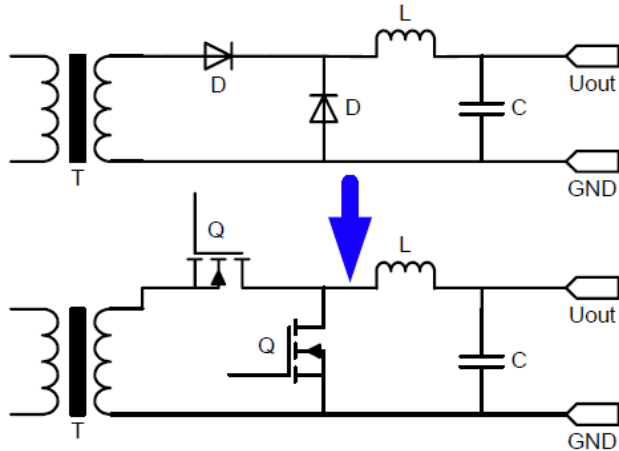
2016.April



MV MOSFET Applications

MV MOSFET : 40V ~ 200V

Synchronous rectification



[Server power]



[PC power]

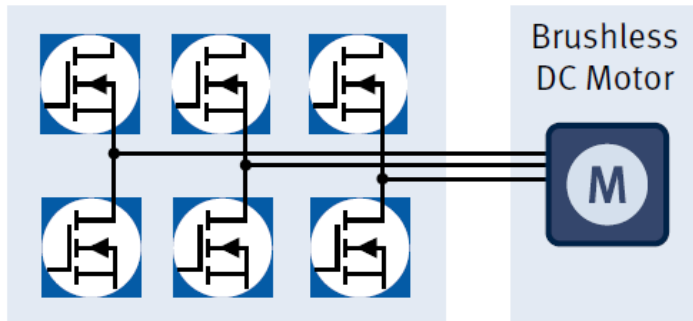


[TV power]



[Mobile travel adaptor]

Motor control in battery power



[E-bike]



[Cordless tool]



[E-vehicle]

MX new generation MV MOSFET

High performance

- Good FOM
- Improved $A \cdot R_{ds(on)}$
- Small Q_g
- Adjustable to Cap Ratio



High reliability

- Improved ruggedness (di/dt , dv/dt , T_{jmax})
- High current carrying capability
- Design for Industrial Applications (Ultra Low $R_{ds(on)}$ & Ideal for low S/W frequency)

Easy to use

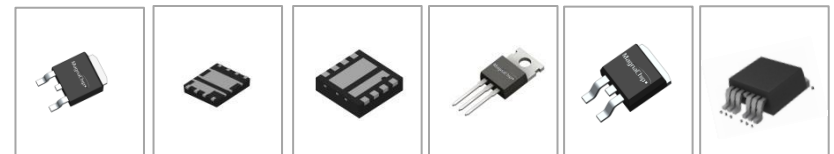
- Expanded product portfolio 40V~150V
- Industry best figure of merit
- High efficiency and power density



**MV
Gen2**

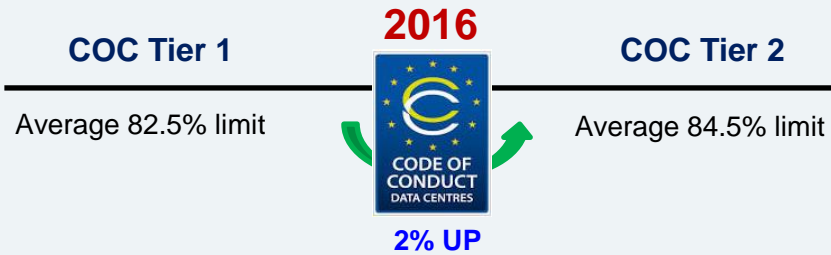
Various packages

- DPAK, PDFN56, PDFN33, TO-220/F, D2PAK, D2PAK 7 leads
- For Secondary Rectification and Motor Drive Applications

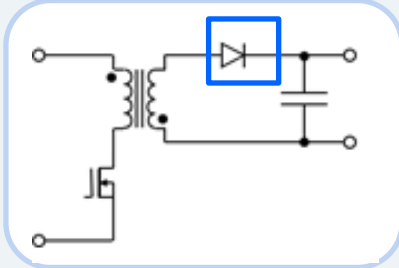


Travel adaptor market (Smartphone)

Specification of Travel Adaptor

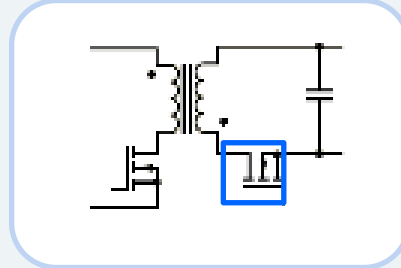


Traditional



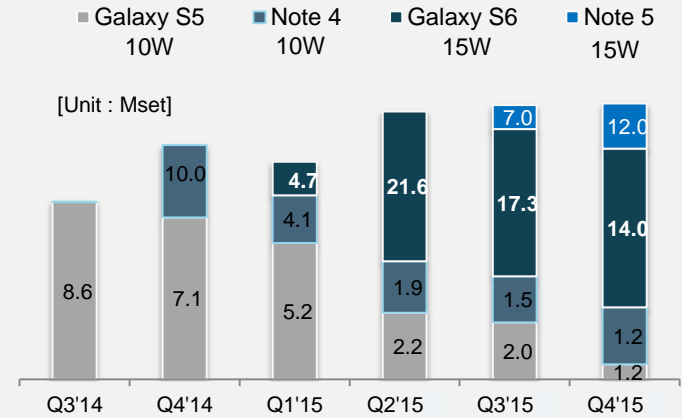
SBD solution

New Trends

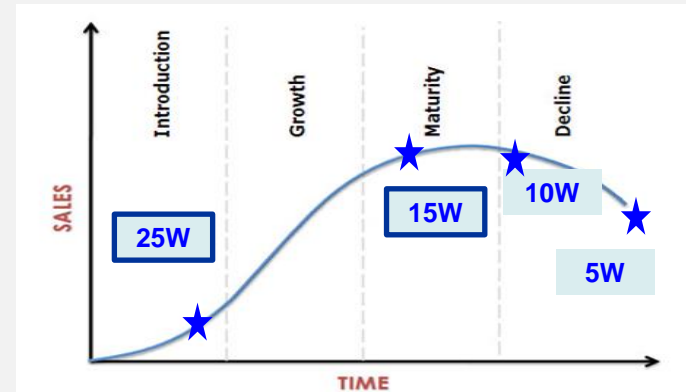


SR MOS solution

Trends of Tier 1 maker

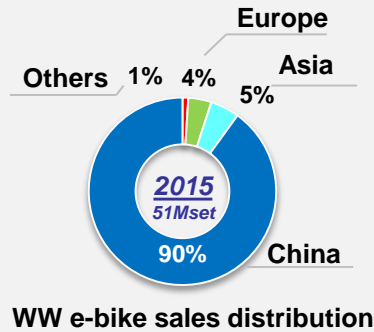
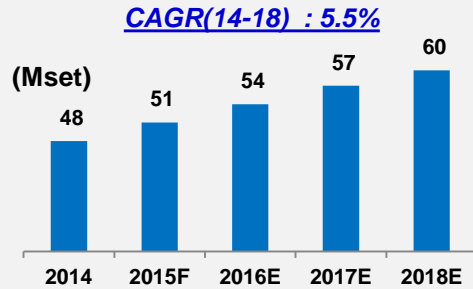


Life cycle of TA



Market of e-bike




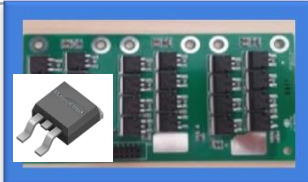
TAM



- Due to cutting CO2 emissions
reducing traffic congestion
WW the largest population
and WW the largest Li-ion
battery production facility



MX Target

	System Power [V]	MOSFET Bvdss [V]	SAM [Mpcs]	% of Portion	MOSFET counts	Target Product	Power System
 [30Mset]	36	60	60	17%	10	MDP10N055TH MDP14N050TH	
	48	70	90	25%			
	60	80	120	34%			
	72,80, 84	100	75	21%			
	96, 108	135,150	9	3%			
 [10Mset]	48	70	30	20%	15	MDE10N054RH	
	60	80	75	50%			
	72,80,84	100	45	30%			

* Source : Market Survey by Technavio MX MSH Sales om 2016.Jan

New product plan for MV MOSFETs

- SR MOSFET**

BV	Product	Rdson , Qg [FOM : Rdson X Qg]	Cap Ratio	Description	PKG	W/S
60V	MDU06N014	1.4mR,xxnC	TBD	Ultra Low Rdson	PDFN56	Jan. '17
100V	MDU10N080	8mR, xxC	TBD	Networking Power	PDFN56	TBD
	MDU10N1K1	110mR, xxC	TBD	Networking Power	PDFN33	Jun. '16
	MDHT10N1K1	110mR,xxC	TBD	Networking Power	SOT223	Jun. '16
	MDU10N100	10mR, xxC	TBD	Travel Adapter	PDFN56	Oct. '16

- Drive MOSFET**

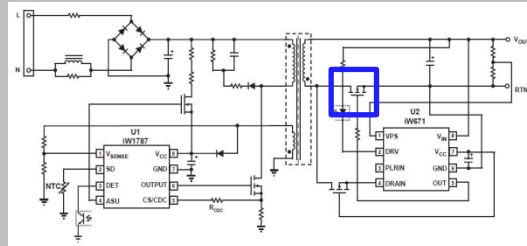
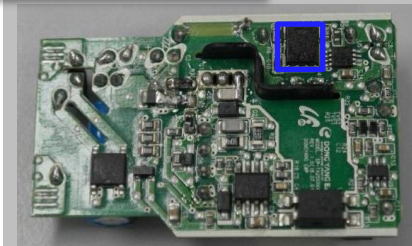
BV	Product	Rdson , Qg [FOM: Rdson x Qg]	Cap Ratio	Description	W/S	
					TO-220	D2PAK
60V	MDES06N010RH	1mR, 120nC	Under 50	Ultra Low Rdson & High Id		Jan. '17 (D2Pak-7L)
80V	MDES08N019RH	1.9mR,120nC	Under 50	Ultra Low Rdson & High Id		Jan. '17 (D2Pak-7L)
100V	MDP10N024TH MDE10N023RH*	2.4mR, 140nC	Under 50	Ultra Low Rdson	Apr. '16	+ 1 Month
	MDP10N055TH MDE10N054RH*	5.5mR, 75nC	Under 50	Best optimized Drive MOSFET	Jul. '16	+ 1 Month
150V	MDP15N075TH MDE15N075RH*	7.5mR, 104nC	214	Under Developing	Jan. '16	+ 1 Month

Product Solution for Travel Adaptor

15W Quick Charger with Synchronous Rectification

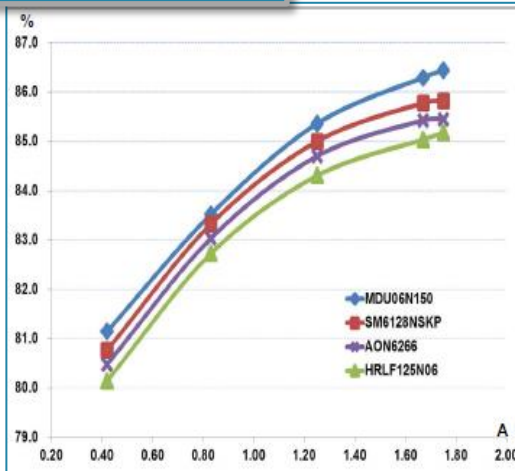
- MDU06N150 is better Efficiency (1%) and Temp performance ($\downarrow 4^{\circ}\text{C}$)

Set Condition



- Efficiency at Normal Load : $> 80\%$ @ 115Vac
- Input mains range : 90~264 Vac, 50~60Hz
- Output voltage : 9V@1.67A continuous operation

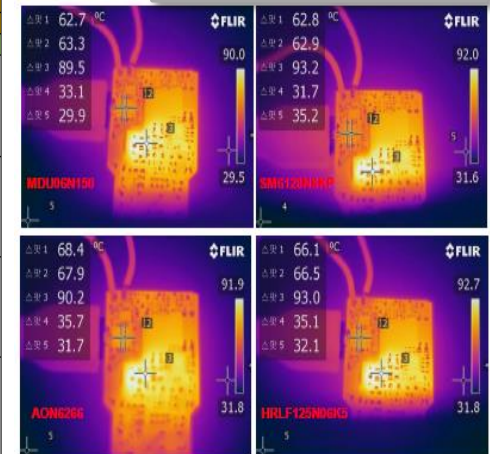
Efficiency



$V_{in} = 264/60\text{Hz}$, $V_{out} = 9\text{V}$

60V SR MOSFET		Efficiency Average(%)							
		MDU06N150		SM6128NSKP		AON6266		HRLF125N06K5	
Vin(V)	Iout Load(A)	Vout=9V	Vout=5V	Vout=9V	Vout=5V	Vout=9V	Vout=5V	Vout=9V	Vout=5V
90V 60Hz	0.42 / 0.5								
	0.83 / 1.0								
	1.25 / 1.5	85.3%	85.2%	84.8%	84.7%	84.5%	84.5%	84.3%	84.1%
	1.67 / 2.0								
	1.75 / 2.1								
115V 60Hz	0.42 / 0.5								
	0.83 / 1.0								
	1.25 / 1.5	86.6%	85.9%	86.0%	85.6%	85.6%	85.2%	85.5%	84.8%
	1.67 / 2.0								
	1.75 / 2.1								
230V 60Hz	0.42 / 0.5								
	0.83 / 1.0								
	1.25 / 1.5	86.2%	84.9%	85.6%	84.5%	85.4%	83.9%	85.1%	83.3%
	1.67 / 2.0								
	1.75 / 2.1								
264V 60Hz	0.42 / 0.5								
	0.83 / 1.0								
	1.25 / 1.5	85.4%	83.9%	85.0%	83.6%	84.7%	83.0%	84.3%	82.6%
	1.67 / 2.0								
	1.75 / 2.1								

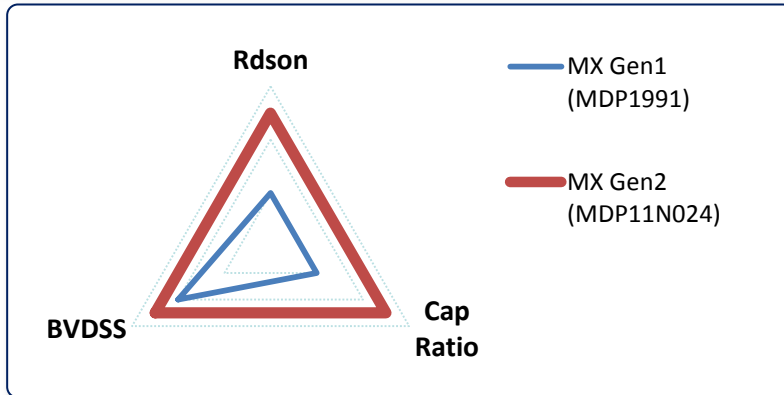
Temp



Product Solution for E-bike and Vehicle

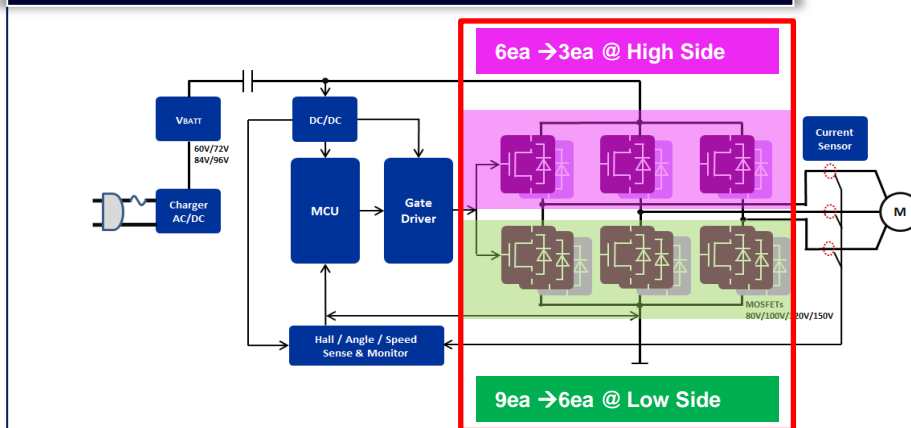
Ultra low Rdson MOSFET vs. Conventional

100V (Gen 2 vs. Gen 1)



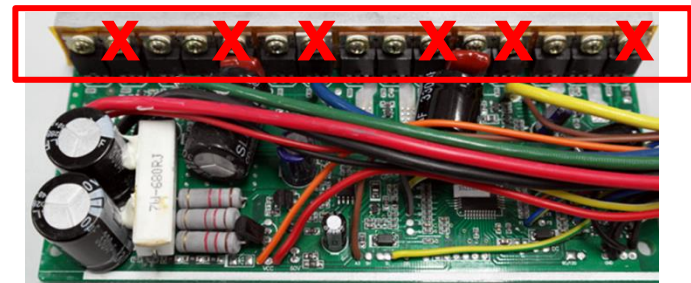
Specification		MX Gen1 (MDP1991)	MX Gen2 (MDP11N024)	Remarks
BOM	MOSFEST counts	15	9	pcs
	Rdson	4.4 (3.9)	2.4	mR
Spec.	Ciss	6750	8000	pF
	Crss	45	160	pF
	Cap Ratio	150	50	Ciss/Crss
	BVdss	100	100	V

System block diagram



Conventional Solution (15pcs MOSFETs)

MX New solution (9pcs MOSFETs)

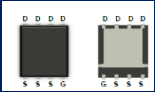



Product Solution for Power tools

Ultra low Rdson MOSFET vs. Conventional

- *MDU04N010 is better $R_{DS(on)}$ & Cap Ratio than IRF6613PbF.*
- *It has been packaged DNF56 standard package.*



Specification			MX			Vs.	IR			Remark
Item	Spec.	Unit	 MDU04N010				 IRF6613PbF			
Static	BV_{DSS}	V	40			=	40			-
	$V_{GS(th)}$	V	1.00	-	2.00	-	1.35	-	2.25	-
	$R_{DS(on)}_{10V}$	mΩ	-	0.85	1.00	>	-	2.6	3.4	Low $R_{DS(on)}$
	$R_{DS(on)}_{4.5V}$	mΩ	-	1.00	1.40	>	-	3.1	4.1	
Dynamic	Q_g	nC	103.5			<	42			-
	C_{ISS}	pF	6,892			>	5,950			High Cap Ratio
	C_{RSS}		147.2			<	460			
	C_{OSS}		2,058			>	990			
	Cap ratio		46.8			>	12.9			
EAS	mJ		450			>	200			

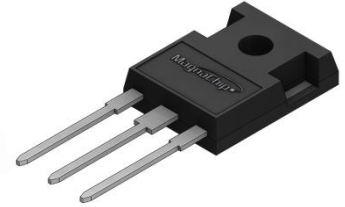
Product line-up

● : Mass production, ▲ : Under development, ◐ : Plan, ○ : Under Review

Product Name	Max $R_{DS(on)}$ @ $V_{GS}=10V$ [mΩ]	40V		60V			80V			100V			150V	
		TO-220	PDFN56	TO-220	DPAK	PDFN56	TO-220	TO-220F	PDFN56	TO-220	TO-220F	PDFN33	D-PAK	TO220
MDx04N010	1.0		▲											
MDx1721	1.4		●											
MDx1722	2.2		●											
MDx1723	2.3	●												
MDx10N024	2.4													
MDx1930	2.5						●			▲				
MDx06N031	3.1			●										
MDx06N033	3.3					●								
MDx1932	3.4						●							
MDx1932	3.6							●						
MDx1921	4.5								●					
MDx1921	4.8									●				
MDx1933	7.0						●							
MDx1933	7.3							●						
MDx15N075	7.5													▲
MDx1922	8.4								●					
MDx1922	8.7									●				
MDx06N090	9.0			●										
MDx06N100	10.0				●									
MDx06N110	11.0					●								
MDx1923	13.9								●					
MDx06N150	15.0					▲								
MDx10N150	15.0										▲			
MDx1051	46.0											●		

APPENDIX

Package information



	TO220	D2Pak	D2Pak 7 leads	TO247
PKG Resistance	0.74mR	0.74mR	0.44mR	0.87mR
Id	120A	120A	180A	120A
Footprint	-	150mm ²	150mm ²	-
PKG Inductance	>10 nH	>5 nH	<5 nH	>10 nH

Note 1) Id is an ultimate current and wire bond is counted on T-post size

Note 2) Wire bond condition is 20mil and wire q'ty is 2 (TO220, D2Pak), 5 (D2Pak 7leads), and 3 (TO247)

Note 3) Resistance is calculated from Heatsink to bottom of lead soldering point

Thank you ~!

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